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Use of carbon diaxide as a breath marker

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Double hierarchical generalized linear models for micro-sensitivity in daily feed intake

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Micro-environmental sensitivity can be studied by estimating the genetic variance in the residual dispersion. Therefore, the objective of this study was to develop double hierarchical generalized linear models for daily feed intake (DFI) in Danish Duroc pigs. This enabled genetic effects for initial, time-trend and residual dispersion in feed intake to be estimated, including their correlations. The resulting model was a natural extension of random regression models, allowing the genetic effect on heterogeneity of residual variance to be estimated. The phenotypic feed intake curve, based on Legendre polynomials, was decomposed into a fixed curve, being specific to the barn-year-season effect and curves associated with the random permanent animal and additive genetic effects. A total of 570,901 DFI records were available on 8,804 Danish Duroc boars between 70 to 160 days of age. Out-of-sample predictions suggested that Legendre polynomials of first order were enough to model the data. The heritability of DFI ranges from 0.08 to 0.12, while the repeatability ranged from 0.30 to 0.35 along the age trajectory. The genetic standard deviation for residual variance was 0.15 for DFI, which indicated a low to moderate genetic variance for residual variance and implied that one unit change in the genetic standard deviation for the dispersion would alter the residual variance by 15%. The genetic correlations between the breeding value for residual variance and breeding values for initial and time trend in feed intake were 0.51 and 0.92, respectively, suggesting effects of scale. Therefore, issues related to scale effects and Box-Cox transformations will be discussed.

Use of carbon dioxide as a breath marker

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For a century experiments with cattle in respiration chambers, feed experiments and feed evaluation experiments have produced knowledge about the feed requirements, feed intake and utilization of different feeds for different production. These results can also be used to calculate the carbon dioxide production of the cattle and the quantitative carbon dioxide excretion of the cattle can be used as a marker for the amount of gasses released by the cattle. By doing this a simple marker that can be used in many different situations has been established. It can be used as a simple, fast and cheap method to estimate the methane (CH_4) production from animals, but it can also be used to quantify the excretion of other gasses as for example acetone to potentially give an indication of a ketosis situation of dairy cows. The amount of carbon in the excreted CO_2 can basically be calculated from the intake of carbon minus the undigested carbon and the carbon in weight gain, the produced milk and in the methane. In practice the CO_2 excretion can be calculated from the intake of metabolizable energy minus the energy in the weight gain or milk produced, as there is close relation between heat production and CO_2 excretion. Cows carbon dioxide production can be calculated which make it recommendable to use carbon dioxide as a breath marker, – like the SF_6 -, when excretion of different gasses are going to be quantified. Different feeds and supplements can be tested in experiments. Moreover, the method can be used large scale to establish the differences between cows. In experiments where the objective is selection for example for reduced methane excretion then the differences between cows most likely have to be corrected for differences in the factors that influence both the methane production and the carbon dioxide production. In short term experiments this is most likely feed intake, if it is known, or milk production.

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